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PROPOSAL FOR 1980 FIELDWORK PROGRAM ON THE HAMILTON - SCOURGE BY CANADIAN SUBMERSIBLES INC.

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Reply to Ottawa office

January 16th, 1980.

Mr. J. R. Jones,
Secretary,
Hamilton-Scourge Steering Committee,
City Hall,
71 Main Street West,
Hamilton, Ontario.
L8N 3T4

Proposal for 1980 fieldwork program on the Hamilton-Scourge by Canadian Submersibles Inc

Dear Mr. Jones:

Enclosed, please find three copies of our Company's detailed proposal for the 1980 program on the Hamilton-Scourge Project.

We would like to call your attention to the fact that we have deliberately submitted the proposal using the tethered submersible "Constructor II". We have done this in the belief that Constructor II will provide a safe and rapid method of completing the survey. We believe that as compared to an unmanned submersible, Constructor II, because of its configuration and its roving and hovering capabilities, will not disturb the artifacts, hulls, spars, etc. The fact that the pilot and co-pilot of the vehicle have both visual and TV siting capability adds to the safety dimension.

We have examined the possibility of completing the survey with both bounce and saturation diving methods and have concluded that from a cost effective and time frame point of view, Constructor II will be more effective.

Should it be the Committee's decision to use an unmanned submersible, or to use bounce or saturation diving, we are prepared to submit a cost proposal.

We believe that our proposal contains all the details required by your invitation to bid. If there are any items which we have missed or on which you require additional information, please do not hesitate to contact me.

Yours sincerely,

George B. Wither

GBW:sm
Enclosures

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DETAILED PROPOSAL FOR THE 1980 PROGRAM ON

HAMILTON - SCOURGE PROJECT

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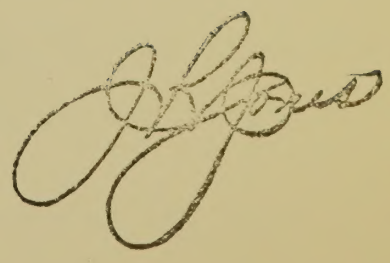

25 JANUARY 1980

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SECTION A

INTRODUCTION

1. Canadian Submersibles proposes to carry out the 1980 program of field work for the Steering Committee of the Hamilton-Scourge Project with the tethered submersible, Constructor II.

The detailed specifications of Constructor II are attached to this proposal in Appendix A. An explanation of some of the sub-systems of this vehicle are contained in Section B.

Canadian Submersibles considers that Constructor II can carry out all the objectives required using the vehicle in a one-atmosphere mode. This proposal deals primarily with carrying out the objectives without diver lock-out. Constructor II can be used as a lock-out diving bell and should the Committee require a diver lock-out, a proposal can be prepared.

2. Surface support will be a barge approximately 180' by 60', having a four-point mooring system.

A tug for towing the barge and setting the anchors will be used. The tug will deploy and recover anchors using the "suitcasing technique" employing a stern winch.

Subject to the availability of suitable surface vessels, accommodation and food will be accomplished either by the facilities on the tug or portable trailer facilities mounted on the barge.

3. The barge will anchor in a suitable location for each target and will remain in position (weather permitting) until all the required objectives have been achieved. Care will be taken to

ensure that anchors will be set well clear of any portion of the targets.

4. It is proposed to operate 12 out of each 24 hours, day or night, to take advantage of weather conditions. Should weather conditions prevent the equipment remaining on location, anchors will be retrieved and the barge will shelter in a safe location, ready to return to site as the weather moderates.

It should be noted that Constructor II can operate in up to a five foot height of sea.

5. Safe operating and working conditions will be observed at all times under the control of the Project Manager.

SECTION B

EXPLANATION OF CERTAIN SUB-SYSTEMS OF CONSTRUCTOR II

1. Constructor II is designed primarily for survey and salvage to a depth of 488 metres. An umbilical trunk line supplies all of the required power, H.P. air, H.P. mixed gas, oxygen, TV signals, communications, hot water for heating, data to surface and safety strength member. The umbilical allows an unlimited dive duration.

2. The pressure compensated ballast system allows the pilot to trim Constructor to a neutral state of buoyancy, and maintain that neutral buoyancy even with changes of depth. This system puts Constructor II in a class by itself with regard to maintaining precise altitude off bottom.

3. The four thrusters mounted on Constructor II produce a total of forty H.P. The thrusters are constant speed with variable pitch propellors which allow precise vehicle speed and control. The port and starboard thrusters rotate 180°, giving a combination of unlimited control in the Forward, Aft, Up or Down direction. The bow and stern thrusters add a third dimension to the control system, ensuring controlled manoevring in cross currents.

4. The navigation systems consist of a Wessmar SS1405 sonar unit with 1600' range with a tilt beam transducer. The range scales are 100', 200', 400', 800' and 1600'. A Digicourse compass unit on board the submersible and a surface repeater in the surface van allows the surface personnel to monitor the readings of the submersible. An aircraft-type gyro compass can be set for magnetic

heading or relative heading. A Digital Depth Indicator will be used to monitor altitude from bottom.

5. A high resolution TV system is mounted to the bow of the submersible and is controlled from the surface monitor rack with 325° travel in pan and 180° tilt. The assembly includes a 35mm colour film camera with strobe light that will take up to 72 photographs per load. There are two adjustable spot lights with illumination control for the TV camera. A TV cassette recorder is interfaced to the surface monitor for continuous documentation of all dives. Voice communications with the crew of the submersible is recorded on one track of the VTR tape. Remote control focusing of the TV camera enables exact focal adjustment to the object. Electronic data display is used to integrate date, time, photo number and present code line into the video signal. The "Electronic Date Display Generator" with built in quartz clock offers the ability to project letters, numbers and separating signs. The data line is composed of thirty digits, each selected from 64 possible signs and is projected across the full width of the monitor screen in light letters on dark background.

6. Constructor II is equipped with 4-1000 Watt B & S lights that are controlled from the inside of the submersible. One of the lights is mounted to the five-function manipulator and allows pan and tilt of the light.

7. Two manipulator arms are mounted on Constructor II:

(a) Five-function type that can lift 400 lbs with a six-foot reach;

(b) Seven-function articulated arm is a dextrous manipulator with a claw that will rotate 360° either direction continuous. It will lift 200 lbs at a five-foot reach.

There is also a 10 H.P. water jet pump which provides a water jet for moving silt or cleaning bottom material.

8. In order to meet the objectives of the in-situ soil tests without the use of a lock-out diving, the following system will be provided.

A Shear Vane device, consisting of a pressure-proof case containing a DC gear-motor, with a shaft speed of approximately three R.P.M., a set of load cells that are mounted to the coupling collar, one-way clutch mounted on the output shaft, case and shaft seal. A water proof electrical cable is provided to connect the drill assembly to the submersible's hull penetrator in order to supply the necessary power to the motor and output of signals from the load cells.

Inside the manned hull, there will be a control box to start and stop and to change direction of rotation. The incoming signal will be interfaced with a strip recorder to document all tests. An important point to consider is that friction on the vane drive rod increases with depth. The unit is designed so as to allow one rotation of the drive rod before the vane is engaged. The drive torque is monitored throughout the cycle and the torque required to turn the rod alone is subtracted from the total torque when the vane is turning.

The drill motor case, drive rod, torque transmission device and shear vane are mounted on a hydraulic ram that is attached to the side of the submersible in a vertical position over the starboard landing pod. Its work can be monitored by the TV camera. There is a hole in the bottom of the landing pod large enough for the shear vane and transmission to pass through. When the hydraulic ram is in the up position, the shear vane is just inside the pod, thereby giving maximum protection to the device when not in use.

SECTION C

METHOD OF OPERATING

1. Because Constructor II is a tethered manned submersible, it allows advantages in the operation not available in other diving systems.

2. The positioning of the mother barge over the target area is not critical to the success of the mission. The mother barge can be located up to 800' from the target.

3. Once the submersible is launched and has descended to bottom, the umbilical will have neutral buoyancy from the umbilical floats that are attached as the sub descends. The sub will have 350' of umbilical to the surface clump. The surface clump is marked with a double float and will maintain the umbilical in a vertical column. The submersible can now move along the bottom to any location within a 800' to 900' radius of the barge with the umbilical supported on the surface with additional floats. This method of deployment allows the submersible to move around a target area without interference from the umbilical (see drawings # 2 and 3).

4. Because the umbilical of Constructor II will be in a vertical column, this allows the submersible to operate around the target area without the umbilical coming in contact with the bottom or the target. This allows the submersible to make turns on its own axis. With the precise control of the ballast system, Constructor II can maintain a mid water position any distance off bottom.

SECTION D

OBJECTIVE ACHIEVEMENT SCHEDULE

1. In accordance with Attachment II of the 1980 Field Work Statement, the first objective is to record visual observations and to make photographic and TV recordings of the vessels and surrounding artifacts.

1.1 Constructor II will be deployed from the mother barge in accordance with the methods of operating detailed previously. The vehicle is then trimmed to a neutral state and manoevred to a starting position at the bow of the target.

Constructor II will then be flown down the side of the target maintaining a clear distance of eight foot from the target.

The VTR camera will pan the side of the target and the lake bottom. Still photographs will be taken in series to accomplish a 30% to 50% overlap of the target.

On reaching the stern of the ship, Constructor II will hover approximately four feet above the stern and then fly from the stern to the bow, completing a video and photographic survey of the target. This will accomplish a double survey of one side.

Constructor II will then be manoevred in the same manner down the opposite side of the target as described above.

On completion of the photographic survey, Constructor II will then attach a buoy line to the centre of the target. On attaching the buoy, it will be released and deployed to the surface while still attached.

This surface buoy will be used as a reference point to deploy four bottom-anchored sonar reflectors.

The original surface buoy will then be recovered and returned to the surface.

A photographic survey of each target can be completed within two days (24 working hours).

1.2 It is submitted that a survey of an area of 75m in any given direction from the centre point of each target can be accomplished by using the in-place sonar targets (drawing #4).

The sonar targets will be bottom-anchored and suspended above the lake bottom to a height of three metres as shown in the drawing.

The sonar target buoys will be positioned from the surface by means of detachable lines. The sonar targets are set in a rectangular formation on the edge of the 75m search pattern.

On satisfactory placement of the sonar targets, Constructor II will be launched and proceed to the target area. The

pilot is then given the compass co-ordinates for the two sonar targets on the side chosen. The search pattern will then be carried out in accordance with drawings # 5, 6 and 7.

Constructor II will be flown at an altitude of two to five feet above the lake bed. All artifacts located will be logged on the master search grid. 35mm photographs of the artifacts will be taken.

This search will accomplish a 10% overlap of the 75m area.

Total time taken for the photo survey and logging of the grid search will be two days per target.

If required, the sonar target reflectors can be left in place as permanent reference points.

2. The second objective of the 1980 Field Work Statement is to identify items and material and to document their location.

2.1 During all phases of the photographic survey, the relative position of artifacts located will be logged on a plotting sheet (drawing # 6).

These artifacts will be numbered and each number will be followed by a brief description of the item located, including details of size, material make-up and identification, if possible.

2.2 With regard to sizing the artifacts, a frame will be fitted between the pods of the submersible. This frame will be manufactured from 2" ABS pipe with a net work of 1/8" yellow cord strung in such a way as to provide a means of measuring (see drawing #7).

2.3 The Project Supervisor will be able to view the area and the artifacts as they are seen by the crew of the submersible by using a VTR screen supplied in the surface support van. Should the Supervisor require, artifacts can be recovered by using the manipulators of Constructor II. Considerable storage space is provided in the pods of Constructor II. This will allow recovery of large artifacts if required.

3. The third objective is to make in-situ soil tests and recover samples of hull and other timbers.

3.1 Using a Shear Vane device described in Section B, it is proposed that a total of ten penetrations per target will be made at three different depths as follows:

- Reading at a depth of 25cm
- Reading at a depth of 50cm
- Reading at a depth of 75cm

The readings will start on one end of each target at a distance of approximately two metres from the hull, seven metres apart. A total of ten samples per target will therefore be accomplished.

The position of the tests will be subject to the situation at the site and changes in position can be made at the discretion of the Project Supervisor.

3.2 A manipulator-controlled boring device shall be employed to recover samples of hull and other timbers.

This device can bore through located timber and retrieve the samples encased in a hollow drill bit.

The project supervisor will be able to choose the samples required from the video and photographic survey. Pressure containers can be supplied, if required, at cost.

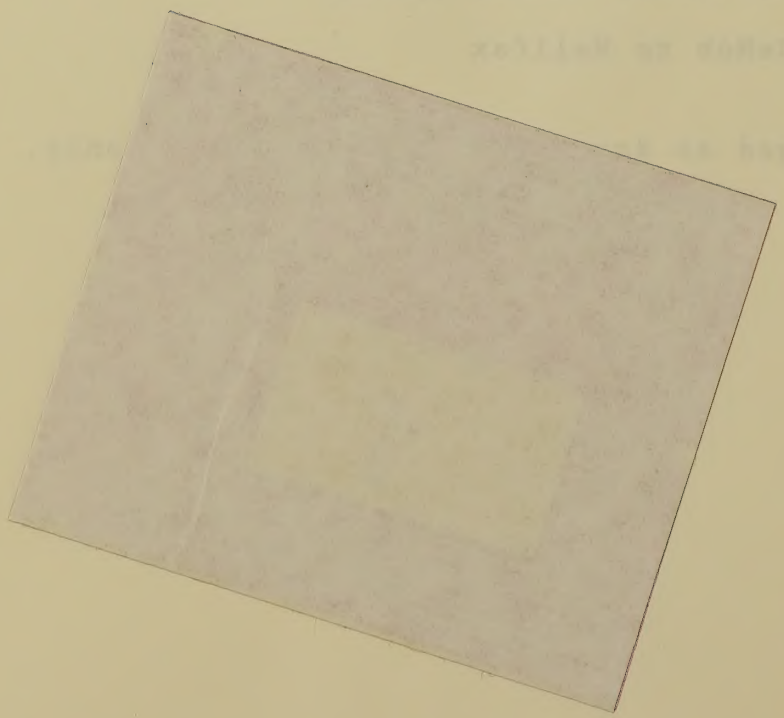
SECTION E

TIME FRAME TO COMPLETE WORK AS OUTLINED

The following is an estimated time frame to complete the work objectives as outlined in Attachment II.

1.*	Mobilization (Halifax - Port Dalhousie)	6 days
2.	Load Equipment - Interface - Systems Tests	3 days
3.	Transit, anchoring to Position 1	1 day
4.	Survey Target # 1	7 days
5.	Relocate Barge - Re-anchor	1 day
6.	Survey Target # 2	7 days
7.	Return to Port	1 day
8.	Off Load, Secure System	2 days
9.*	DeMob to Halifax	5 days
		33 days

* Not charged as day rate, One-time charge only.



SECTION F

PERSONNEL STRUCTURE

1. Curriculum Vitaes for senior personnel to be employed by Canadian Submersibles are contained in Appendix 3.

1.1 Constructor II personnel required under this proposal are:

(a) Project Manager

(b) Operations Director

(c) Chief Pilot

(d) Co-pilot

(e) Electronic Technician/Surface Support Van Operator

(f) Winch Operator

(g) Life Support Technician/Hot Water Boiler Operator

(h) Documentation Technician

(i) Boat Operator

(j) Surface Diver

All the above are paid on a per diem basis, whether operating or on stand-by.

Personnel will be required to be available 24 hours per day and work 12 of each 24 hours.

1.2 Barge and tug personnel will be supplied within the rental/lease figure.

SECTION G

COSTS

Costs are broken down in two sections viz:

1. One Time Charges
2. Per Diem on Site

A total Estimated Cost is submitted for planning purposes only. The total is NOT to be construed as a FIXED PRICE BID.

1.	ONE TIME CHARGES	
1.1	Mobilization and Demobilization (including personnel travel, transportation, etc) can be invoiced cost + 15% administration	$ 14,500.00
1.2	Supplies	
	.1 Sonar Reflectors 8 x $125	1,000.00
	.2 Grid Frame	100.00
	.3 Diesel Fuel	1,590.00
	.4 Soda Sorb	180.00
	.5 Gasoline and Oil	284.00
	.6 Video Tapes	4,305.00
	.7 Drager Tubes	150.00
	.8 Non Recoverable Cordage	400.00
		$ 8,009.00
1.3	Insurance	
	Wording to be negotiated - Best Estimate	$ 6,500.00
1.4	Report Cost including duplication	$ 2,500.00

2.	PER DIEM	
2.1	Personnel - as outlined	$ 2,160.00
2.2	Constructor II and all its ancillary Equipment	3,750.00
2.3	Barge (Estimate as quoted) Including crew and crane	1,200.00
2.4	Tug (Estimate as quoted) Including crew	1,500.00
2.5	Crews' Quarters & Galley	100.00
2.6	Meals, including Cook and Helper	460.00
		$ 9,170.00
3.	TOTAL ESTIMATED COST - Not to be construed as a FIXED PRICE BID	
3.1	One Time Charges	$ 31,509.00
3.2	Per Diem Estimated @ 22 days Except tug @ 18 days	195,740.00
	TOTAL	$227,249.00

SECTION H.

MISCELLANEOUS

1. Should this proposal be acceptable to the Committee, it is the intention of Canadian Submersibles to do evaluation tests during April/May 1980 in Bedford Basin at Halifax, Nova Scotia. The evaluation tests will be fitted into the present plans of Canadian Submersibles to carry out specific testing at that time.

2. Canadian Submersibles will make available to the Steering Committee a casette tape demonstrating the performance of Constructor II. This casette tape clearly shows the vehicle's ability to fly, hover mid-water, manoevre around a specific target and various uses of the manipulators.

3. Standby and down time conditions are extremely difficult to project. Canadian Submersibles proposes that down time condition be defined as:

(a) Weather down time - the per diem charges as outlined under Section G shall be reduced by the amount of $3,000.00 per diem.

(b) Contractors' down time - If for any mechanical reason it is impossible to continue the survey or complete 12 hours of work in a 24 hour period, it shall be the Contractor's sole liability for all costs incurred after the first 24-hour-period.

4. This proposal assumes that services and facilities normally supplied for docking of the barge and loading and unloading the equipment will be provided.

5. In case of a dispute, Canadian Submersibles is prepared to accept the Association of Professional Engineers as an arbitrator.

6. Canadian Submersibles is a Canadian company, headquartered in Ottawa, Ontario, with their operational facilities in Dartmouth, Nova Scotia. The tethered submersible Constructor II is registered under the Canadian Shipping Act and was built in Thunder Bay, Ontario.

With the exception of one man, the personnel to be employed will be Canadian.

Surface support equipment to be provided are presently based in Lake Ontario.

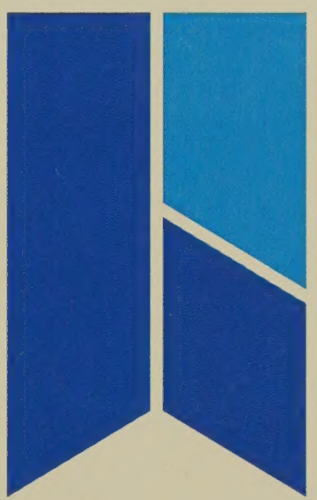
APPENDIX 1

CONSTRUCTOR II

A TETHERED SUBMERSIBLE

Placeholder for Foldout.

Insert to Be Photographed at a Later Date.



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The CANSUB Constructor is a tethered manned hyperbaric submersible, certified by Det Norske Veritas to operate in water depths to 1,650 feet. The design overcomes the power/duration problems typical to small manned submersibles and gives data acquisition and surface monitoring at the worksite. It flys within the scope of its molded umbilical complex and navigates with a standard high resolution sonar and compass system. Surface supplied power, communications, hot water and high pressure gases provide for divers lockouts.

Equipment includes 1,800 feet of umbilical cord and related umbilical drum apparatus.

The pilot compartment is a single space pressure vessel designed to withstand an internal/external pressure of 50 ATM. It contains 113 cubic feet of volume and houses all controls and HP plumbing for operation of the submersible and life support equipment for personnel. The steel hull is coated externally with syntactic foam for thermal protection and buoyancy, and has a single hatch door that seals against internal or external pressure with a rotating bayonet locking seal. A medical lock is provided and additionally a trunk and mate up flange extend below the hatch door for mate up to a DDC or subsea habitat.

The hull is fitted with an external framework, providing protection and mounting brackets for all external equipment.

Dropable ballast is attached with release hooks operable from inside the hull. Ballast consists of a 1500 lb. landing pod framework providing a work platform when on bottom. The landing pod skis provide storage for manipulator and diver tools and space for recovered objects, sediment core tubes, extra trim weights, emergency tools and construction materials.

General Specifications:

A. Certification:

1. Hull Construction - Det Norske Veritas

2. Class - "Attended Sub" - American Bureau of Shipping

B. Dimensions:

1. Length.....15' 2" (4.62 M)

2. Beam ..... 9' 6" (2.89 M)

3. Height.....11' 8" (3.56 M)

4. Weight .....16300 lbs. (7,394 KG)

5. Payload ..... 2200 lbs. (998 KG)

6. Gross Weight .....18500 lbs. (8,391 KG)

C. Pilot/Diver Pressure Hull:

1. Inside diameter .....62.9" (1.598 MM)
2. Inside height .....82.6" (2,098 MM)
3. Internal volume .....113 FT^3 (3200 Liter)
4. Hatch clearance .....27" (700 MM)
5. Hatch door .....30" (770 MM)
6. External pressure rating .....50 BAR
7. Medical lock pressure rating .....30 BAR/tested to 39 BAR
8. Internal pressure rating .....50 BAR/tested to 65 BAR

D. Construction Material:

1. Fine grain steel pressure hull- coated with syntatic foam
2. Steel exostructure
3. Aluminum brackets and aluminum V.B. spheres

E Gas Supply: (Onboard)

a. 8 fiberglass storage spheres, 300 FT^3 each @ 3000 P.S.I.

b. 2 oxygen bottles 80 FT^3 @ 3000 P.S.I.

c. 1 - 50 FT^3 @3000 P.S.I. helium bottle for purge system

F. Operating Characteristics:

1. Endurance - limited only by crew endurance, virtually unlimited power to supply all functions from surface via umbilical
2. Depth - 1,650'
3. Speed - maximum 3 knots
4. Flys within scope of buoyant umbilical

G. Life Support:

1. Endurance for self contained emergency is 160 man hours normally supplied from surface via motors.
2. CO_2 scrubber and heater units - made by kinergetics, powered by 24 VAC/DC magnetic drive motors.
3. BIBS (built-in breathing supply) unit full face masks with closed cycle life support electronics PO_2 monitored sensors.

4. PP-1 Units: Closed Circuit backpacks, provide 6-hour life support for diver excursions using electronics to monitor sensors.

5. Onboard gas provides 2400 FT^3 of mixed gas supply to operate buoyancy control system or pressurize for diver lockout. 160 FT^3 oxygen for emergency life support.

6. Standard litre flow O_2 for metabolic oxygen.

7. Oxygen Analyzer - 3 provided.

   a. Teledyne: O_2 sensor, meter readout 0-1 ATM

   b. Bio Marine: oxygen sensors (3) in electronic logic circuit, monitors 0-2 ATM, controls BIBS unit, or monitors and controls cabin PO_2

   c. Draeger Tube Colormetric - chemical analyzer.

8. Carbon Dioxide Monitor

   a. Beckman ACDM unit with power/control feature turns on scrubber at pre-set limit
   b. Draeger tube-hand pump type chemical colormetric indicator

   Surface:

   a. air bank - 4880 FT^3 @ 2250 P.S.I.

   b. HeO_2 bank 5856 FT^3 @ 2250 P.S.I.

   c. oxygen bank 1200 FT^3 @ 2250 P.S.I.

H. Syntatic Foam:

1. Hull coated up to 10" thick with 32 lbs. density Emerson Cuming foam for thermal protection and buoyancy.

2. Three fixed buoyancy devices; fibreglass hydrodynamic shapes, cast full of 24 lbs. density foam providing 2400 lbs. of buoyancy in fresh water.

I. Power:

1. Umbilical supply 480 VAC, 30, 60 HZ power, from a 45 KW generator supplies main power to submersible.

2. Onboard supply: emergency battery power is provided by 4 aircraft batteries giving 180 amps/hr. of 24 VDC power for cummunications, internal light and life support functions.

J. Propulsion:

1. Four identical thrusters with controllable pitch propellors. One forward fixes lateral, one stern rotatable 90°, two on sides rotatable 180°. Combination of four thrusters allows manoeuvring three directions simultaneously. Motors run at constant speed, proportional control joysticks vary pitch in propellor blades from zero to full power, forward or reverse.

2. Thruster motors are 440 V. 3 phase induction motors, pressure compensated, set up to deliver 10 hp at 1850 rpm.

K. Navigation:

1. A Wessmar SS140S sonar unit is provided with 1600' range and a tilt beam transducer.

2. A Hydrophone - Pinger Receiver System is used to relocate targets.

3. A Digicourse Compass Unit is used with a surface repeater readout and a aircraft type compass is used as backup.

L. Main Power Box:

1. Surface power via the umbilical power conductors is connected to the box which houses the motor starting circuits and main transformers to reduce the 440 VAC to 110 VAC and 24 VAC/DC power.

2. Only 24 VAC/DC control voltages enter the manned hull and all high power functions such as 1000 watt, 110 VAC lights, thruster motors, hydraulic pump motor and jet pump motor are actuated with relays in the sub's power switch box.

3. Additionally, all high power functions are part of the ground fault detection system.

4. The unit is pressure compensated with Dialex transformer oil.

M. Hydraulic Power Box:

1. Power from the power box and control voltages from inside the hull operates a hydraulic pump and motor and disperses fluid at 1000 P.S.I., 6 GPM with 21 directional control valves.

2. The unit is pressure compensated with hydraulic fluid and has external quick connect high flow connections for diver hand tools.

N. Manipulators and Tool Package:

1. 5 function arm - is a grabber that can lift 400 lbs. at a 6 foot reach. Its prime function is object/artifact recovery or to fix the position of the sub to aid the articulated arm while working with tools.

2. 7 function articulated arm - is a dextrous manipulator with a claw that will rotate. It will lift 200 lbs. at a 5 foot reach. The claw is designed to hold a standard T-shape handle that can hold a variety of tools.

3. Tool array consists of cut-off saw, cable cutter, impact wrench with attachments, jet nozzle, winch, core drill and a Jacob's chuck mounted on a T-handle for use with a hole saw, star drill etc.

O. Main Variable Ballast System:

1. Due to virtually unlimited air supply available through the umbilical, the ballast tanks are pressure compensated with air and are maintained at 15 P.S.I. above ambient pressure. This allows the use of lightweight aluminum spheres for ballast tanks rather than heavy pressure resistant hard tanks.

2. There is sufficient onboard gas to blow both ballast tanks at full submergence depth, and they provide 1800 lbs. of variable ballast.

SURFACE SUPPLY AND MONITORING SYSTEMS

A. General Description:

1. The submersible vehicle, being classed as an "Attended Submersible" requires a group of support equipment and crew to perform within the design goal parameters. The major link from submersible to surface being the umbilical, which is tendered (reeled in and out) and stored on an umbilical winch. Utilizing a gas rotary valve, and an electrical slip ring assembly, the umbilical components are all connected to a control van which in turn is supplied with main power from a generator, HP and LP gas and hot water. All communications equipment, television control and monitoring equipment, and ancillary monitoring equipment are contained within the control module.

   All systems are packaged in a compact single lift configuration and are air or road transportable. No single unit weighs more than 10 tons including the submersible.

B. General Specifications:

1. Surface supply module (S.S.M.) - Control Van

a. 6' X 8' steel frame van, wood panelled and insulated;
b. single door access with 3 windows, contains the following equipment:

(i) Gas supply console with depth gauges;
(ii) Main PWR supply and metering switch-box and ground fault detection system;
(iii) Television and camera pan and tilt control console with VTR and tape cassette recording system;
(iv) Instrument box containing digital depth readouts, digital compass heading display, remote temperature readouts, wireless radio unit, Helle hardwire, helium unscrambler radio unit and a surface junction box for additional access to conductors through umbilical to inside or outside submersible;

c. Module penetrator boxes (2) providing connections for all incoming and outgoing supplies

2. Umbilical Complex:

a. manufactured to special design by Vector Cable Co. - Texas

b. moulded, cabled complex 1800' long consisting of the following components:

(i) (2) ½" diameter HP gas hoses for breathing gas and buoyancy control;
(ii) (4) ¼" diameter HP tubes for depth sensing and oxygen supply;
(iii) (1) ¾" diameter hot water hose for sub hull and diver heat;
(iv) (1) 4 conductor #10 power cable for main power;
(v) (1) television coax, power and control cable and sub complex;
(vi) (2) communications and data control cables with 7 twisted shielded pairs each; extra conductors available for multiplex signals or extra control functions

c. All these components are cabled, that is gently twisted and coated with insulation and sealing material.

d. Complex then has a Kevlar filament braid sheath which provides a breaking strength of 22,000 lbs.

e. The external coating is polyurethane, ½" thick yellow in colour for visibility and provides waterproof sheath for entire length of umbilical;

f. Umbilical terminates through a stainless steel shoe which provides attachment hooks and exits the various components into individual whips which are then terminated at the various connections.

3. Umbilical Winch:

a. Manufactured by Undersea Equipment Co. Limited to special design:

(i) steel frame 8' x 16' with control operator house attached drum stores 1800' of umbilical and has a 50" diameter level wind sheave that fair leads umbilical over side of ship or moonpool or ice launch hole powered by 20 HP air motor, optimum air supply requires 300 CRM at 100 P.S.I.;

(ii) control module, attached to frame contains hard-wire communication to SSM and digital depth and compass heading readouts. It is heated, has good visibility for tendering umbilical and has inside control level for two spotlights;

(iii) all electrical connections to umbilical are provided by a 60 pass electrical slip ring. Allows transmission of main power, signal data, communications, T.V. coax and control simultaneously without cross-talk interference;

(iv) all HP & LP gas and hot water connections to umbilical are provided by a 10 pass gas rotary valve;

(v) maximum pull strength of drum on bottom layer is 5000 lbs. at 100 FPM.

4. Hot Water Boiler:

a. Manufactured by Diving Unlimited International

(1) Model Mark 6B provides 8-10 GRM at up to 200 P.S.I. at up to 200°F

(ii) Requires 440 VAC power to drive pumps and control systems and requires pressurized water source.

(iii) Total auto temperature control

5. LP/HP Gas Supplies:

a. Gas Bank #1 provides 6000 cubic feet of mixed gas or air at 2250 P.S.I. and 1200 cubic feet of oxygen at 2250 P.S.I.

b. Gas bank #2 provides 5000 cubic feet of air at 2250 P.S.I.

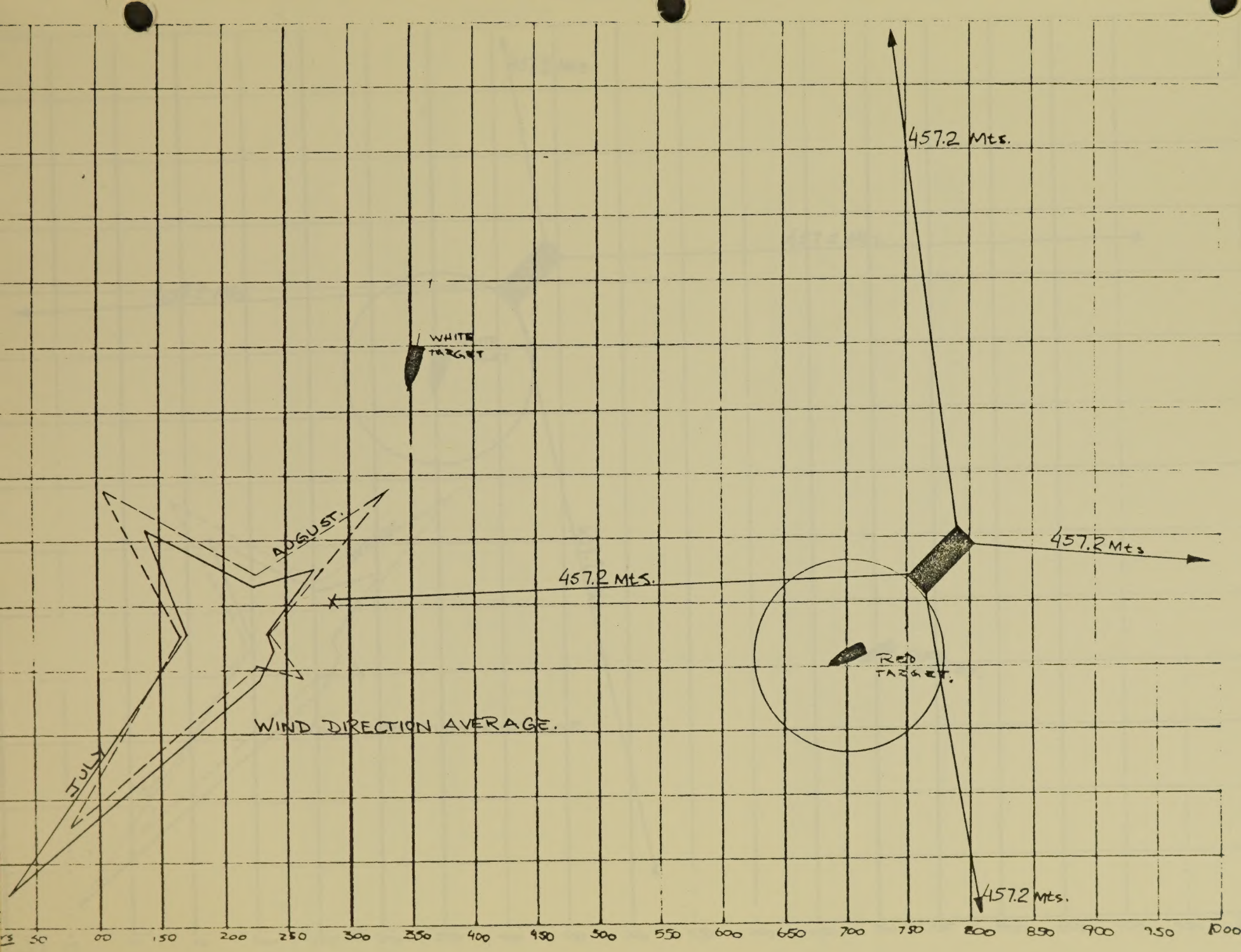
c. Charging panels and gauges are provided on each steel frame module, and connection whips are routed to the SSM penetrator boxes.

6. Surface Power:

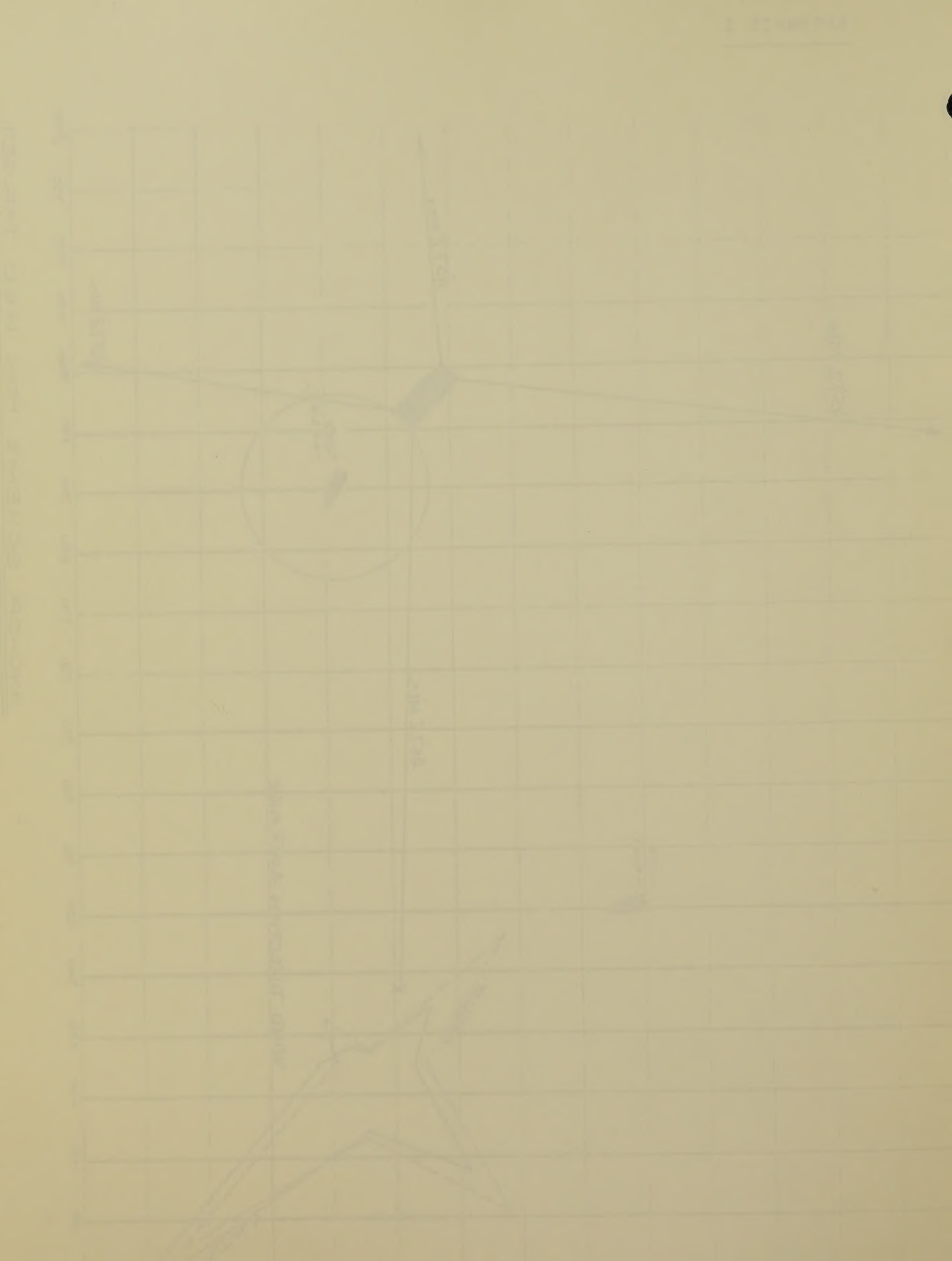
a. Kohler, diesel driven 45 KW generator plant provides 440 VAC, 3 phase, 60 cycle power to sub, max 60 amps.

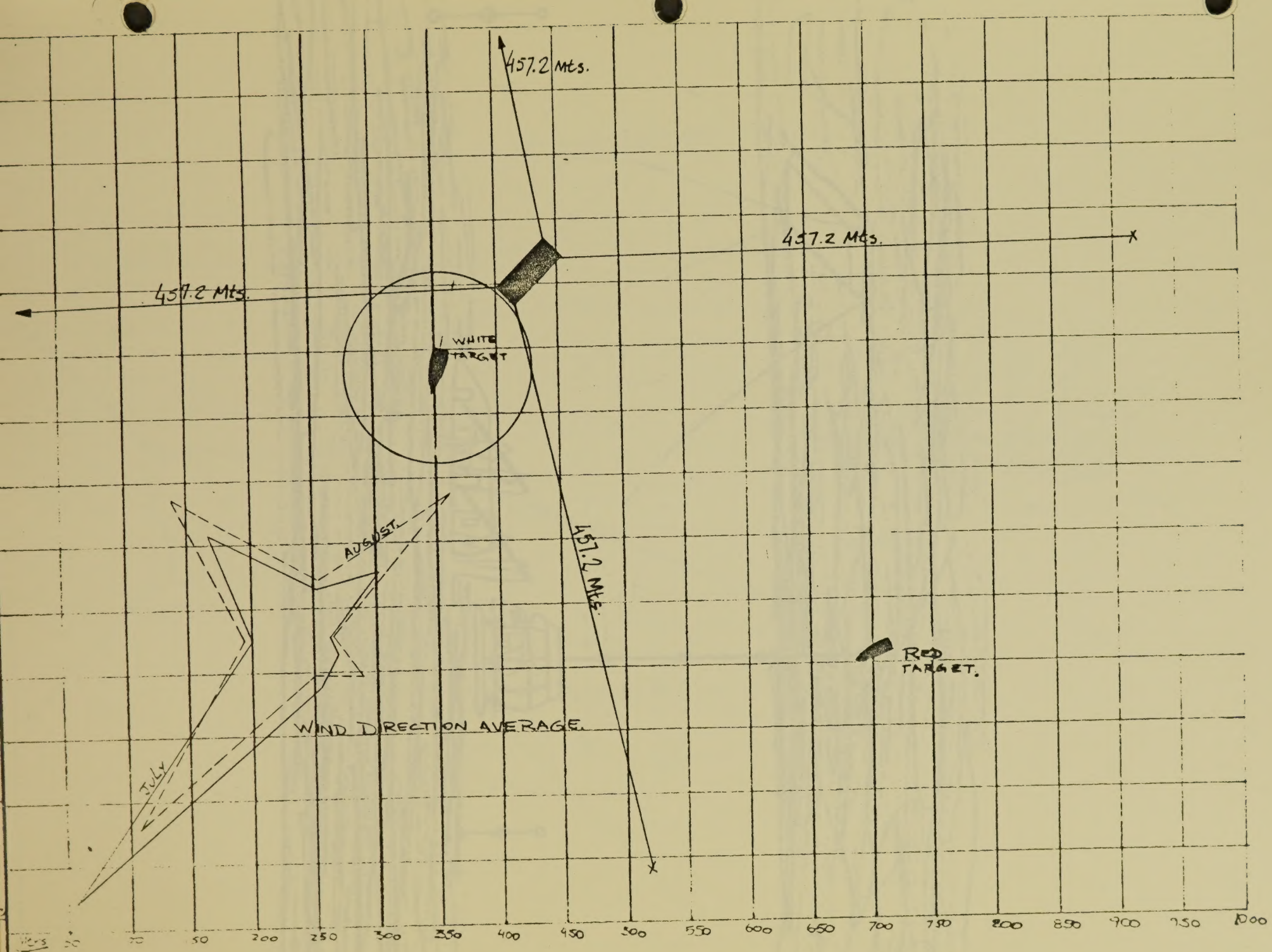
b. All sub power systems integrated with surface J-box with ground fault detection-interruption system which has variable sensitivity on the interruption mode.

c. Power submersible, hot water boiler, control van and winch control house.

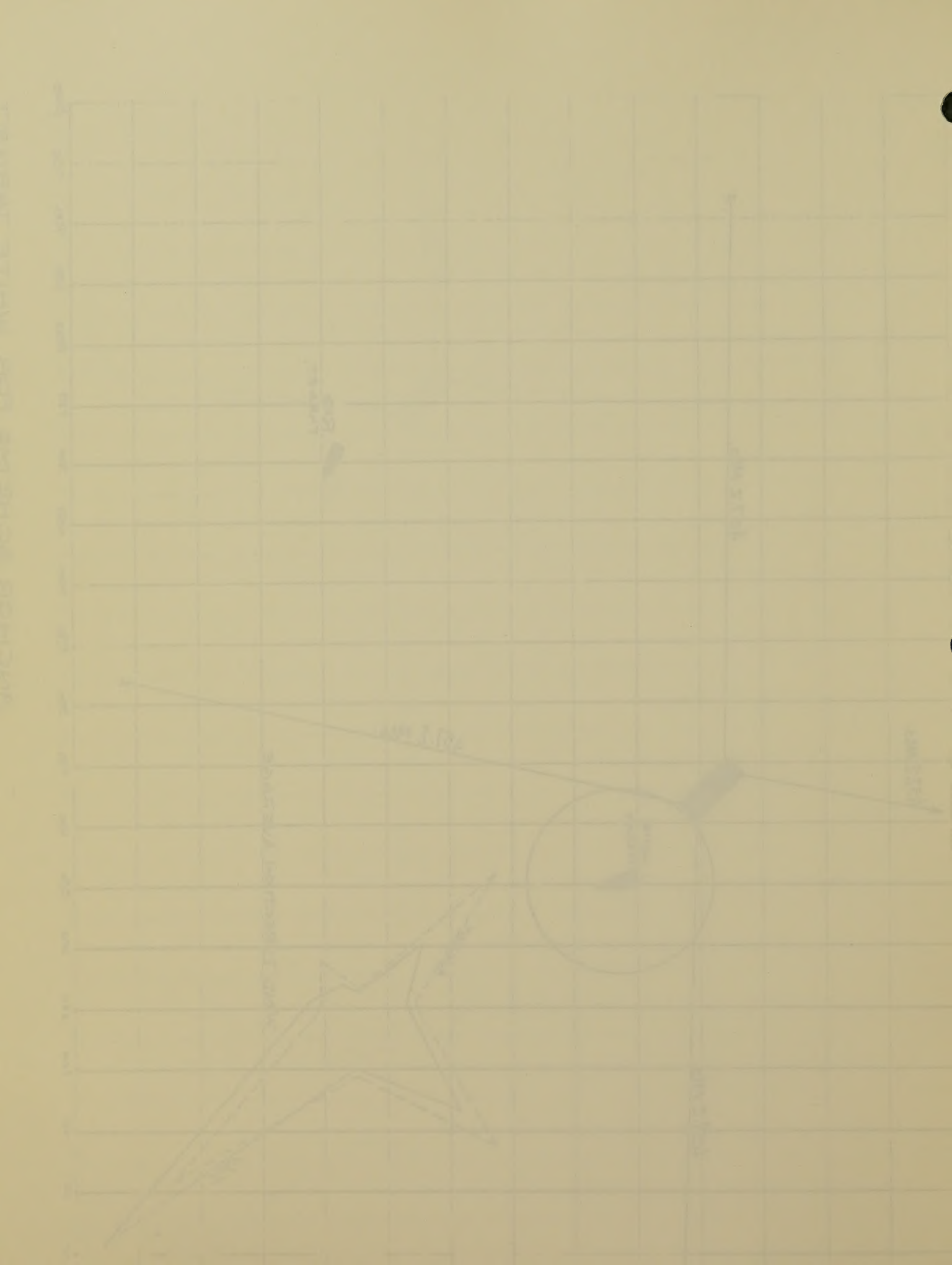


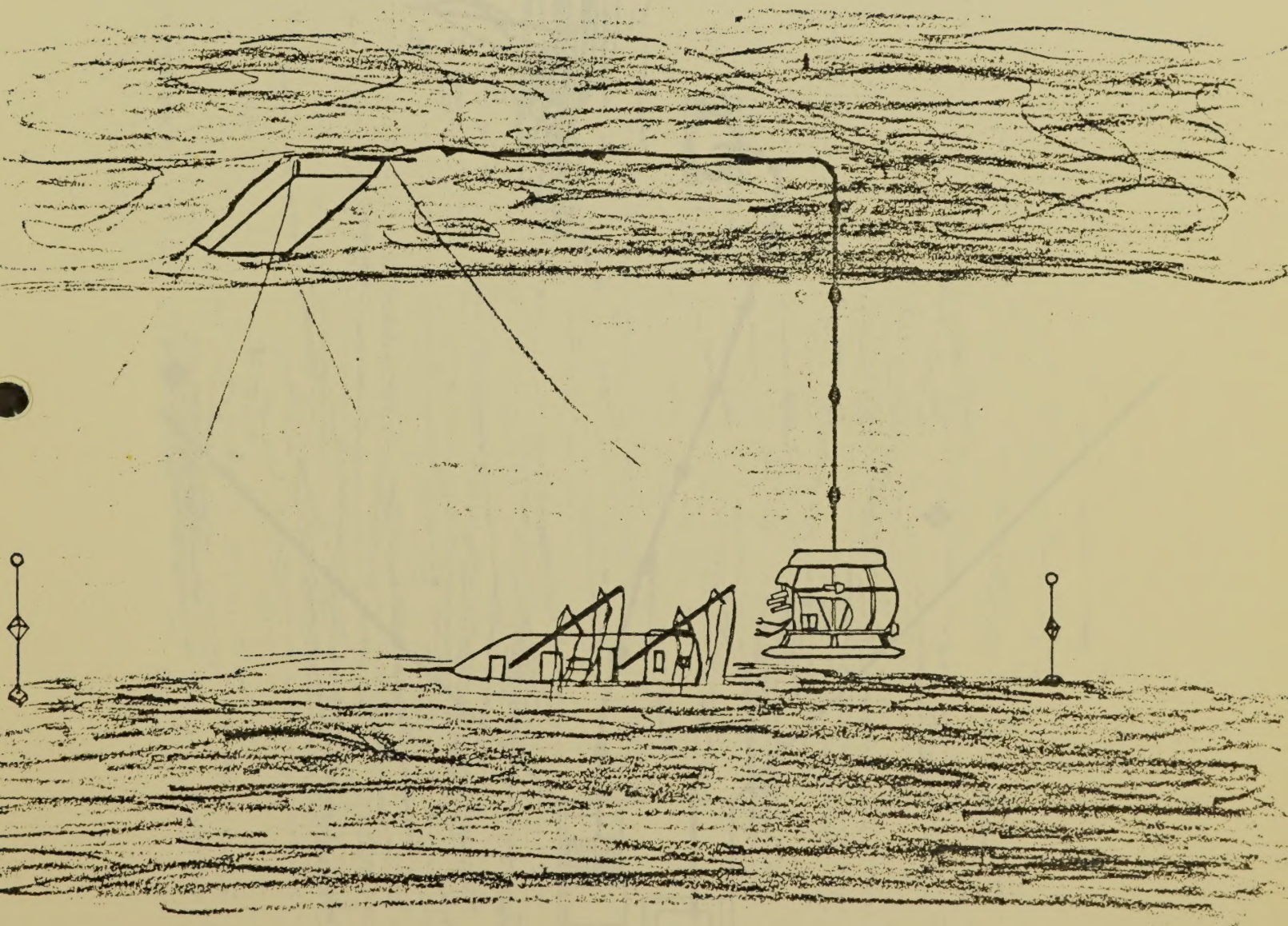
ANCHOR SCHEME FOR RED TARGET.

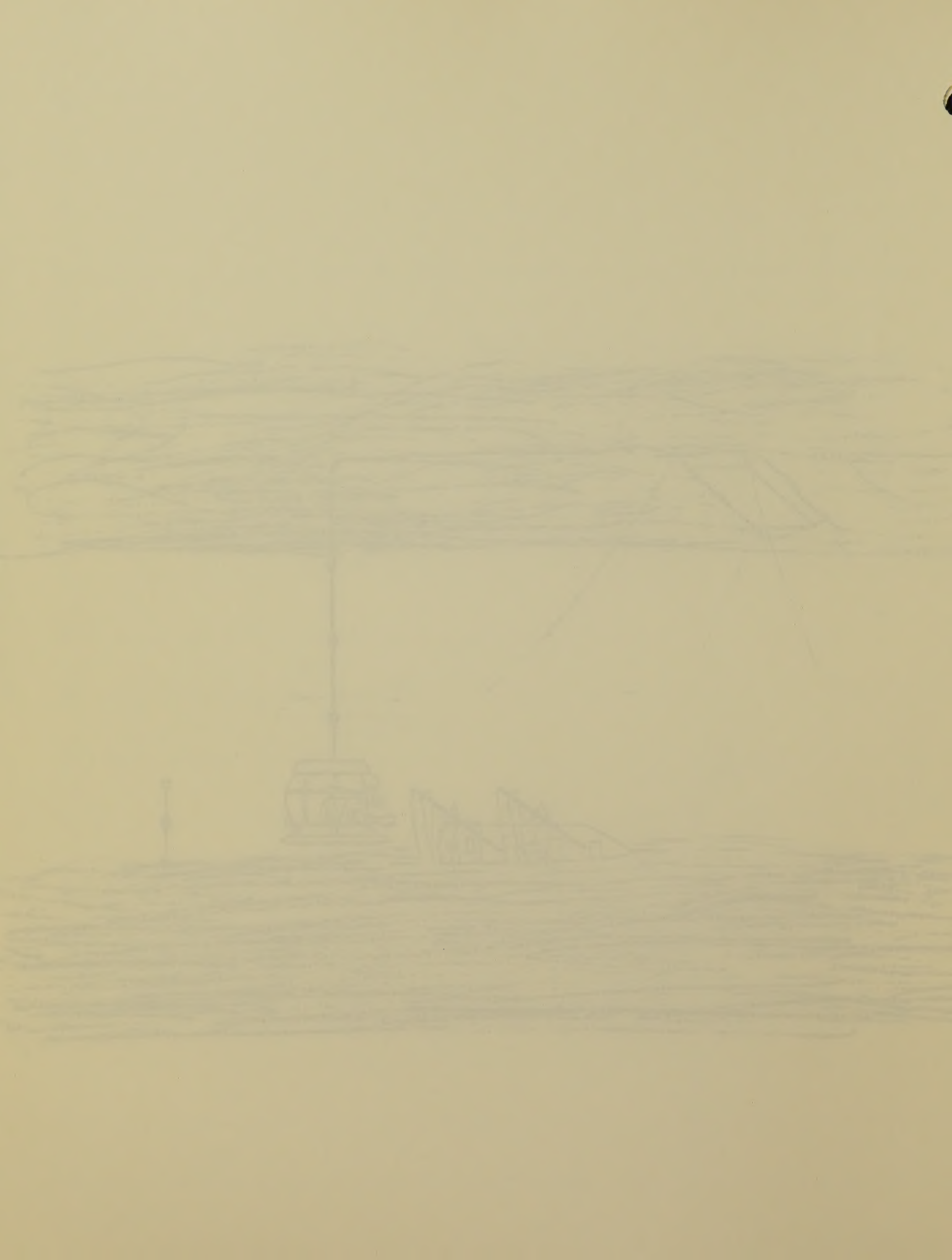


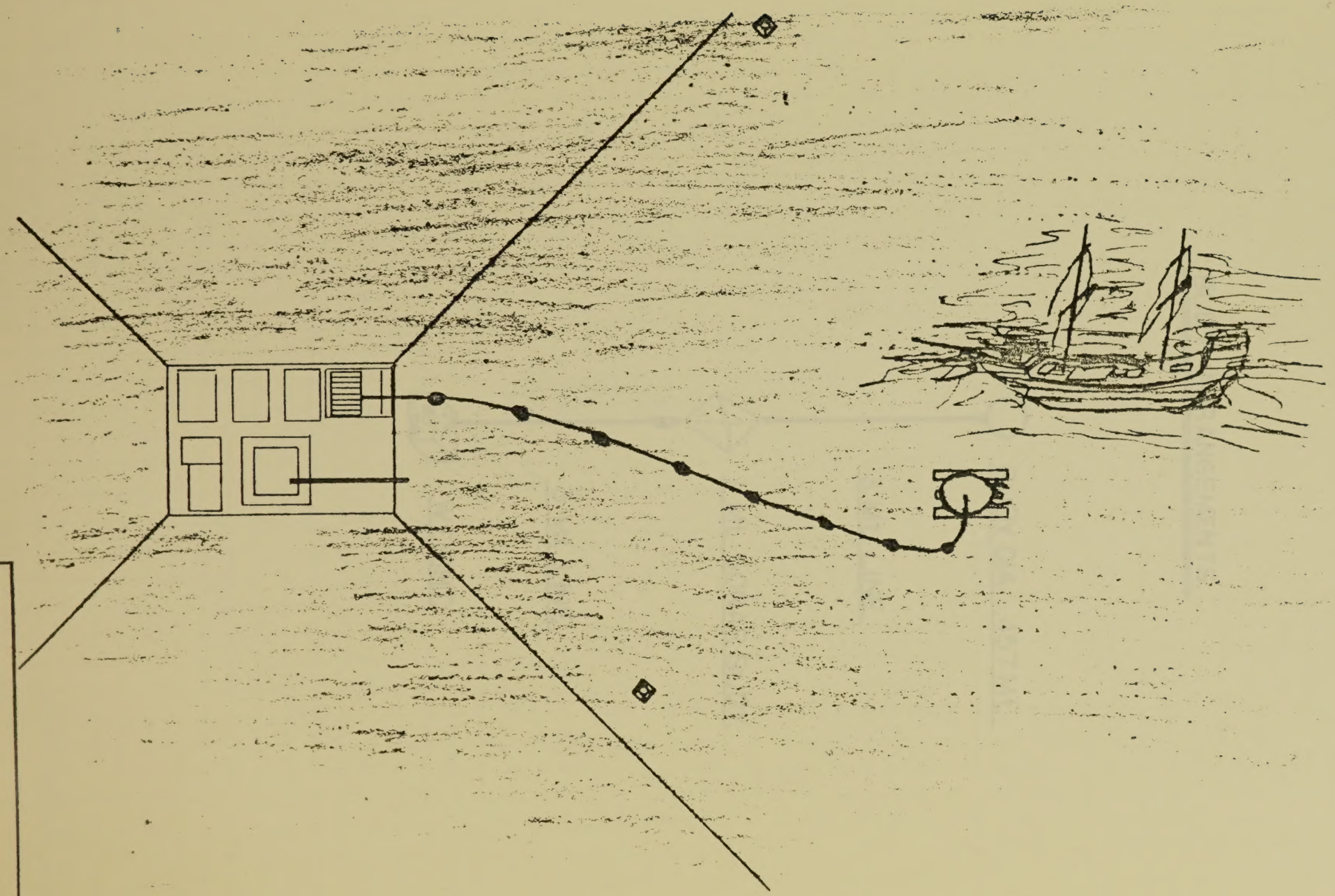


ANCHOR SCHEME FOR WHITE TARGET.









DRAWING # 3.

BUOY ARRANGEMENTS.

BUOY DIA. .457 Mt.

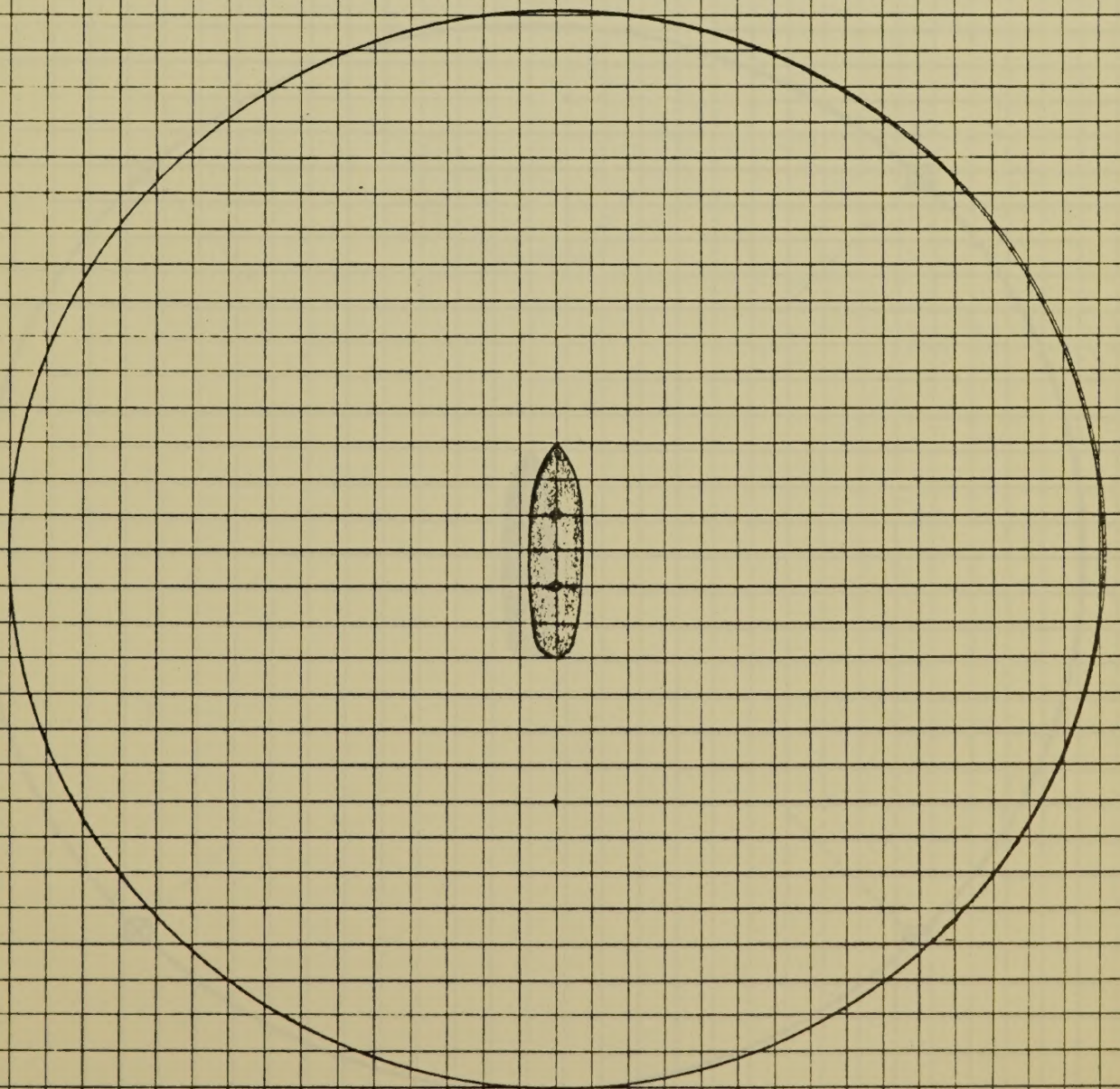
3 Mt. LINE.

1 Mt. SONAR BUOY.

3 Mt. LINE.

WEIGHT.

TARGET:_____ HEADING:_____ DATE:_____



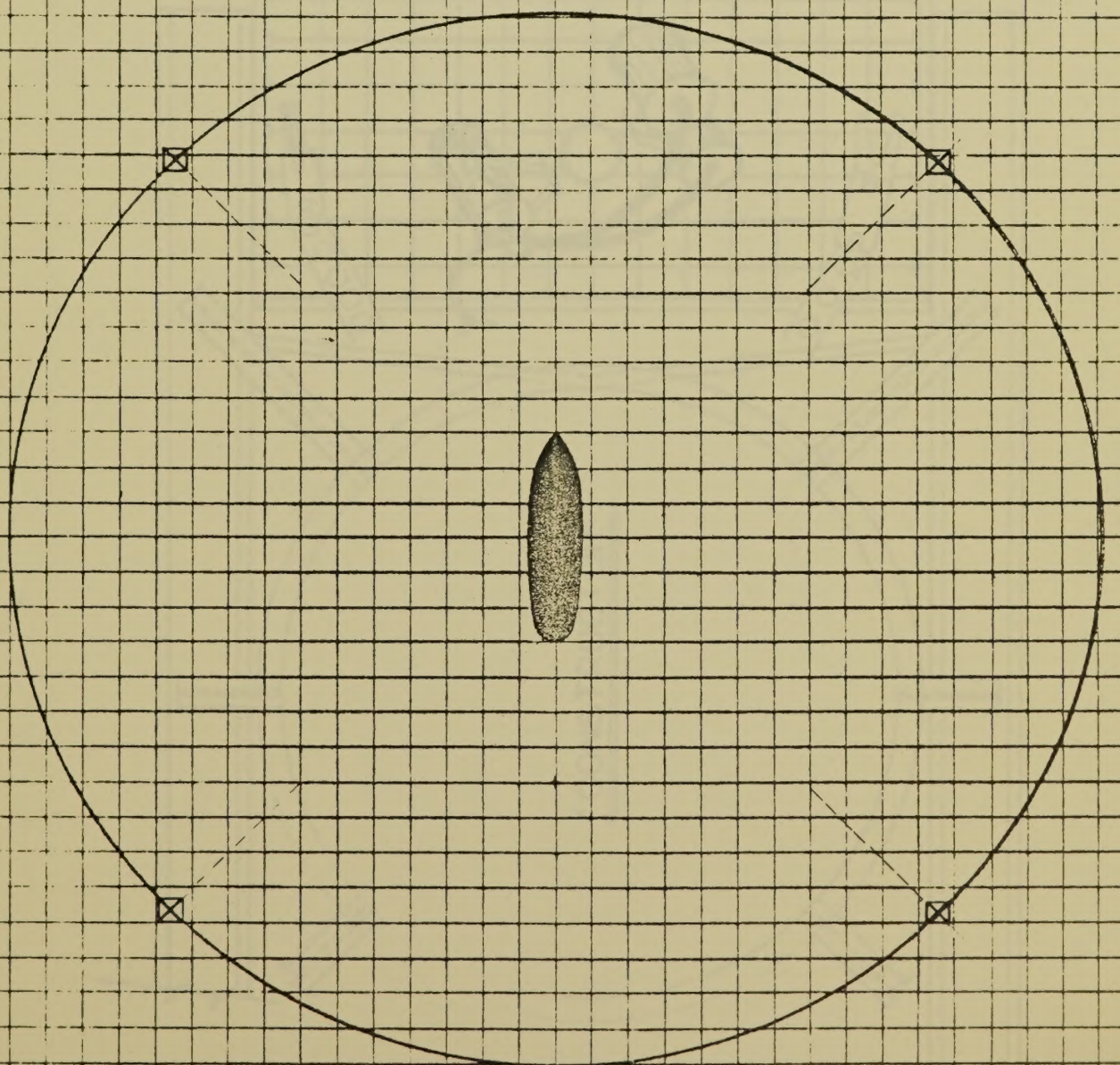
FOR ACCTUAL USE, THIS GRID WILL BE REPRODUCED ON A 24 x 36 INCHES DRAWING SHEET.

DRAWING # 5.

0 5 10 15 20 Meters

ARGET:_____ HEADING:_____ DATE:_____

SONAR BUOY LOCATION.



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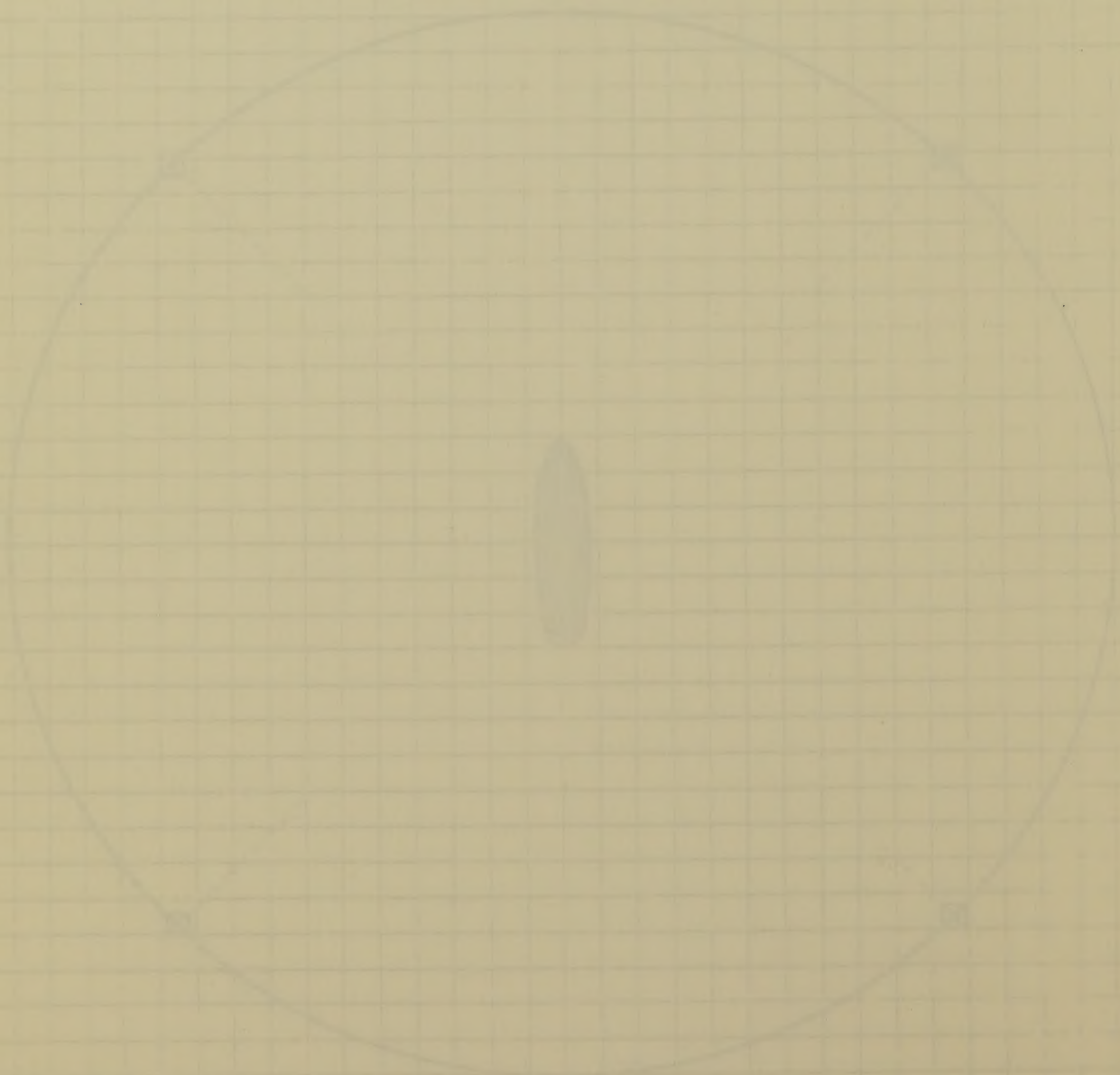
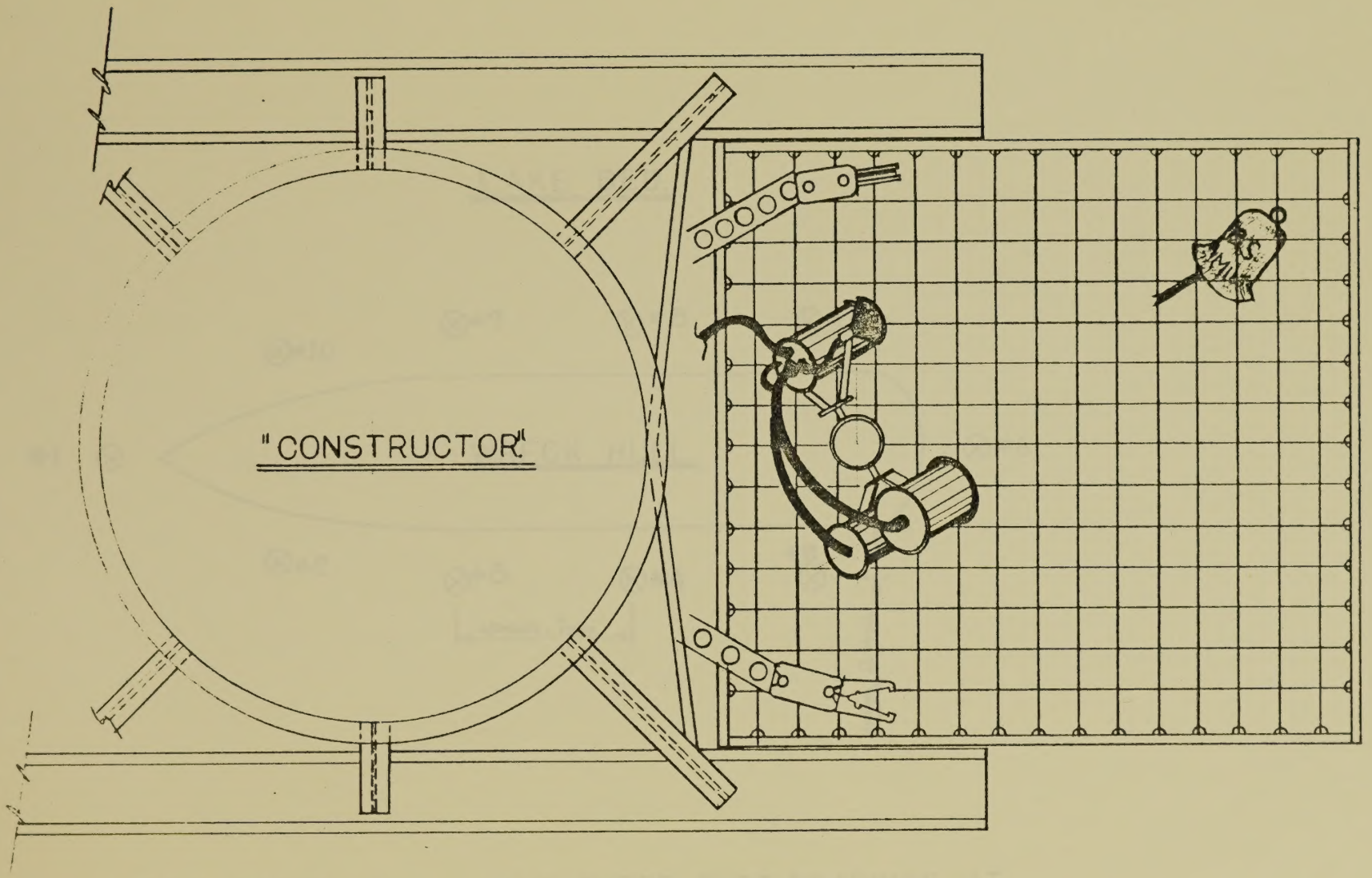
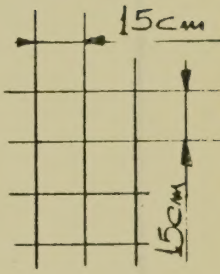
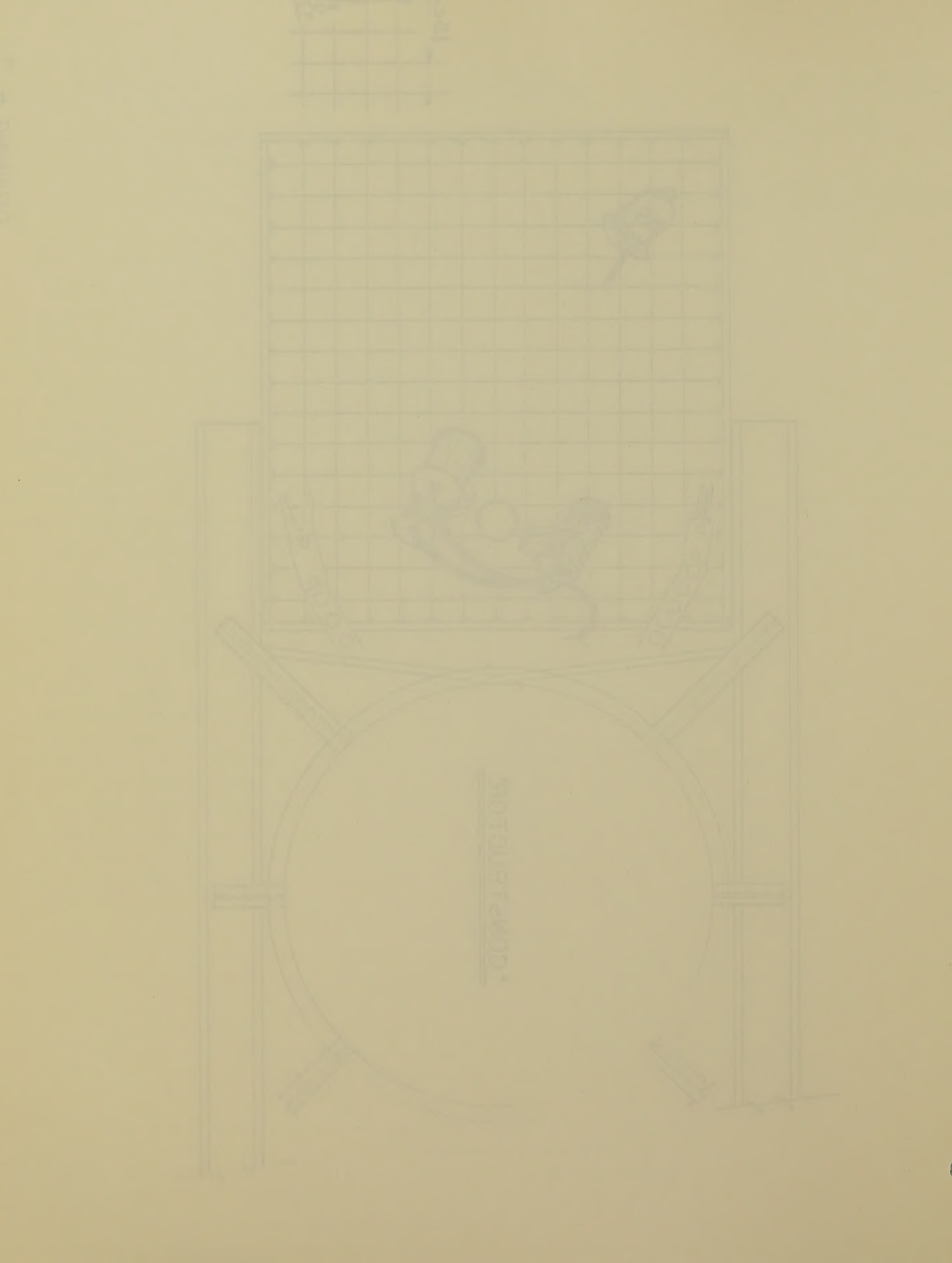


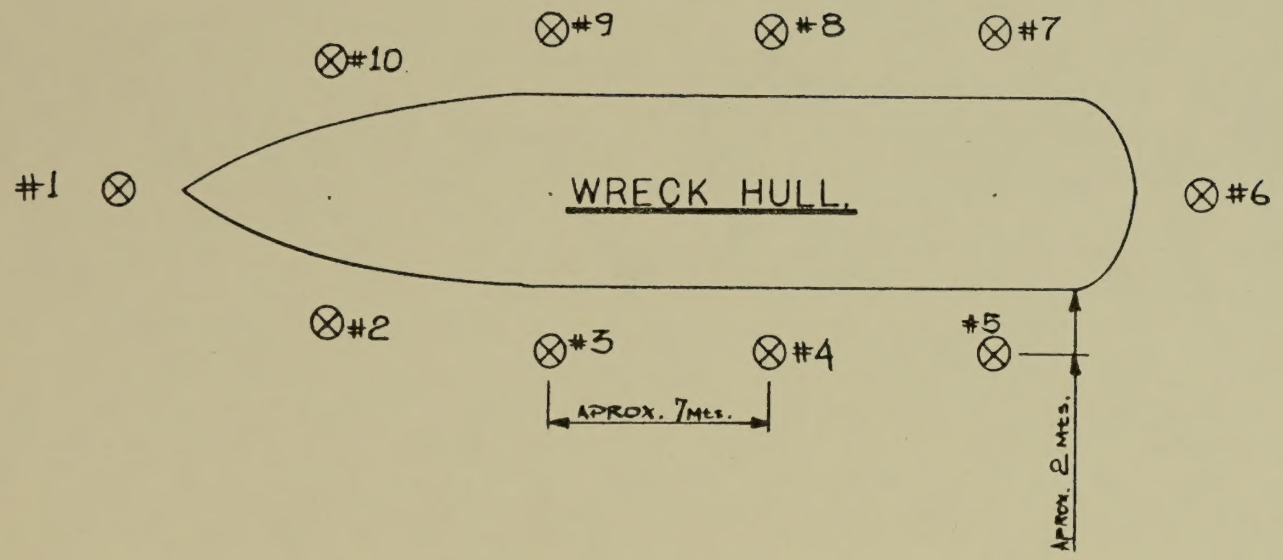




DRAWING # 7.



IN-SITU SHEAR VANE TEST.



EACH POSITION WILL HAVE THREE TEST READINGS, AT 25 Cm, 50 Cm, 75 Cm. DEPTH'S.

DRAWING # 8.

APPENDIX 3

R E S U M E

1. PROJECT MANAGER

2. OPERATIONS MANAGER

3. DIVING SUPERVISOR

4. SENIOR PILOT

5. CONTRACTS MANAGER

R E S U M E

POSITION: Project Manager
Canadian Submersibles

Educational Background

1. Graduate Royal Canadian Naval College

2. Graduate Royal Naval College, Greenwich

3. Graduate Specialized Torpedo and Anti-Submarine Qualification, Royal Navy

Historical Background

1. 18 years of service as an officer, Royal Canadian Navy

2. Appointments include:

   (a) Executive Officer serving in:

   - battleship (1)
   - aircraft carriers (2)
   - destroyers (8)
   - frigates (3)
   - corvettes (1)

   (b) Senior Instructional Officer - Torpedo and Anti-Submarine School

   (c) Officer in Charge - Tactical Warfare School

   (d) Sea Trials Officer - East Coast

   (e) Staff Torpedo - Anti-Submarine Officer - CAN COM FLT

   (f) Staff Operations Officer - CAN COM FLT

   (g) Commanding Officer, HMCS Victoriaville

3. Additional qualifications:

   (a) Qualified Diver - Royal Navy

   (b) Master Mariner

R E S U M E

POSITION: Operations Manager
Canadian Submersibles

Employment Summary

1978 - present:	Canadian Submersibles, Halifax, N.S.
Responsibilities:	Complete submersible system, "Constructor" for certification. Train and supervise system personnel. Directed the operation of "Constructor II".
Position:	Submersible Operations Manager
1977-1978:	James Dean Marine Divers, Harvey, Louisiana
Responsibilities:	Supervision of deep water pipe inspection to 350'. Maintain and service the closed circuit life support systems. Train divers in the use of the system. Supervise dives.
Position:	Closed Circuit Life Support Supervisor
1976-1977:	Safety Sea Systems, Ponchatoula, Louisiana
Responsibilities:	Designed and built prototype SS-20 Helmax diving helmet. Designed and built closed circuit life support system for Ocean Corporation for use in nuclear reactors using SS-20 Helmax. Trained Ocean Corporation personnel in use of system.
1974-1975:	Innerspace Services Corporation, Harvey, Louisiana
Type of Business:	Divers safety products, design and manufacturing.
Responsibilities:	Design and fabrication of PP-1 Closed Circuit Dive System, maintain fabrication facility, directed R.& D. of new products, assistant to training director of Closed Circuit Diving School. Field tested all products offered for sale. Established maintenance programs for PP-1 System; designed and fabricated non-magnetic helmet of Closed Circuit design and fabricated non-magnetic helmet of Closed Circuit design that is adaptable to the CCR 1000 backpack for the U.S. Navy, E.O.D. Participated in open water 500 feet lockout with Johnson Sea Link Submarine of the PP-1 Closed Circuit mask assembly. Responsible for inventory control and purchasing raw materials.

R E S U M E

POSITION: Diving Supervisor
Canadian Submersibles

Employment Summary

1960	Qualified Clearance Diver
1963	Commercial Deep Sea Diving Qualification, Venezuela Oil Fields
1964-1967	Marine Contracting Ltd. Underwater construction in Nederland Texas Oil Field Diver - Gulf of Mexico
1968-1969	Lead Diver - Persian Gulf Pipe-laying
1970-1971	Lead Diver - Gulf of Mexico
1975-1979	Taylor Diving & Salvage Co. Inc. Diving Supervisor - Diving Superintendent in the North Sea.
Responsible for:	Bell Diving Saturation Systems Safety Officer Maintenance Officer

R E S U M E

POSITION: Senior Pilot
Canadian Submersibles

Employment Summary

January 1971	Taylor Diving and Salvage - New Orleans Apprentice Diver
August 1971	Epic Divers, New Orleans, La. Trained in underwater welding, drilling technician. Extensive oil field diving - inspection, well head work, salvage, construction and under-water photo survey, licensed in the state of Louisiana to handle explosives.
January 1973	Innerspace Systems, New Orleans, La. Trained as a technician in the use of closed circuit rebreather. Extensive diving experience in deep gas diving using closed circuit rebreather. Trained in handling H.P. oxygen, HeO^2 mixers and air. Involved in filming for CBS the wreck of Andrea Doria in the capacity of Closed Circuit Diving Supervisor, in charge of all H.P. cases and closed circuit back packs.
January 1975	Deep Diving Systems Limited Diver, Life Support Technician Closed Circuit Technician, Hydraulic technician.
January 1979	Canadian Submersibles Supervisor, Life Support Closed Circuit Breathing Systems Hydraulic Systems Pilot "Constructor II"

R E S U M E

POSITION: Contracts Manager
Diving Superintendent
Canadian Submersibles

Qualifications

Fully qualified to supervise, dive, operate, repair, test and evaluate the following diving equipment:

(a) Diving Operations to maximum depth of the following equipment using HEO^2, Air, N_2O_2, O_2 :

1) Hard Hat (Air)
2) Hard Hat-HEO_2, United States Navy
3) Kirby Morgan Mask: i) MK 8
ii) MK 9
iii) MK 10
iv) MK 16
4) Rat Hat: participated in trials and evaluation of this equipment
5) AGA Breathing Apparatus, Scuba Pro, Calypso, Aqualung, Poseidon, Healthways, as well as single and double hose breathing apparatus.
6) Aquadyne Fiberglass Umbilical Fed Hat
7) Closed Circuit Pure Oxygen Breathing Set (CDBA)
8) Semi Closed Mixed Gas Slayden (N_2O_2)
9) Semi Closed Mixed Gas (CDBA)
10) Desco (Jack Brown) Shallow Water Umbilical Fed Mask
11) CCR 1000 Electrolung (Biomarine) Mixed Gas Rebreather
12) H.P. & L.P. Maintanace to R.C.C. D.D.C. and related equipment

(b) Instruct, supervise or participate in any of the following operations:

1) demolition, surface and underwater
2) underwater surveys utilizing video-tape television systems
3) cable or pipe trenching using: i) explosives
ii) high pressure water jet
iii) air lifts
iv) drilling pneumatic

(c) Welding, cutting or burning, surface and underwater.

(d) All types of marine salvage and wreck disposal

(e) Lockout Diving Operations: i) tethered bell
ii) lockout submersibles

(f) All types of miscellaneous underwater work, including hydraulics, air mechanical explosive activated equipment, i.e. ship repair or salvage cathodic protection, cable or pipeline installations.

(g) Navigate in coastal vessels as Navigation Officer or as Officer of the Watch.

(h) Supervise, operate, diagnose and treat for decompression sickness, burst

Special Skills

(a) Underwater Demolition
(b) Wreck Disposal
(c) Coastal Navigation
(d) Wreck Historian

Work History

1962 - Ships diver - participated with Russian divers in St. Johns

1963 - Ships diver - commercial diving, Bermuda

1964 - Ships diver - wreck salvage cargo, Halifax area

1965 - Ships diver - wreck salvage, Maritime area

1966 - Qualified second class diver

1967 - Deep Sea Diving School - instructor

1968 - Diving tender - ship repair

1969 - Diving tender - attack team
- Commercial diving, underwater telephone cable survey
- Commercial diving, Department of Mines & Energy Resources
- Commercial and military diving operations with the Department of Fisheries, Bedford Institute of Oceanography, entailing bottom core sampling using Perry Lockout Submercable Self Diver.

1970 - First Class Deep Sea Divers Course (Canadian)

1971-
1973 - Submersible (SDL-1) Lockout Diving Supervisor. Promoted to Master Corporal.

1972 - Promoted to Sergeant

1973 - First class diver, mixed gas and salvage course, Naval School of Diving and Salvage, Washington, D.C.

1974 - Master Divers course (D.C.I.E.M.) Defense Research Establishment

1975 - Toronto, Ontario - employed as experimental diver, advancing to underwater ordinance disposal course, graduating as Academic Leader, Maryland, U.S.A.

- Master Divers Course (D.C.I.E.M.) This work included conducting trials and excavations on new diving equipment which will be incorporated in the Canadian Armed Forces and all types of technical guidance to civilian authorities.

- Assisted Research Scientists in all types of experimental studies

1976 - Toronto, Ontario - Canadian Forces Deep Sea Diving Team (D.C.I.E.M.)

- Promotion to Warrant Officer
- Fleet Diving Unit, Shearwater, Nova Scotia - employed as diving instructor for advanced senior personnel (level 3 and 4) in marine salvage and new diving equipment.

1977-
1978 - Completed course in Senior Leadership and Personnel Management

- Successfully completed course in the Art of Instructional Technique
- Employed as senior instructor at Deep Sea Diving School Atlantic

1979 - Contracts Manager and Diving Superintendent, Canadian Submersibles

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